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ECOBASE/soil, a programme for data management
and biodiversity analysis of soil animal communities

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ABSTRACT. ECOBASE/soil is a software developed under 4th Dimension for the Macintosh, which combines a relational database with analysis tools for the study of the structure and the diversity of soil animal communities. Using the powerful sorting and searching capabilities offered by the database system, any subset of samples or species/taxa can be directly handled for various ecological data manipulations ranging from index calculations to similarity measures. Results can be exported under different formats for complementary analysis.

INTRODUCTION

Soil community ecology is a fuzzy science, where a large number of environmental parameters, often poorly delimited, interact to determine an unstable organisation of living communities. A considerable amount of data has therefore to be processed in order to obtain significant indications about community structure and dynamics.

Managing this information on the long term is best performed by the use of database systems. Analysing data is currently only possible via statistical programmes external to the database.

ECOBASE/soil introduces a new approach by combining both features in a same programme: it has been designed as a relational database programme under 4th Dimension for the Macintosh, with advanced capabilities of ecological data manipulations and analyses (except multivariate analyses).

THE DATABASE

Data are stored in five interconnected master-files:

- 1) the sample file ("Relevés") with data about the samples;
- 2) the species/sample file ("EspRel") and the taxon/sample file ("TaxRel"): each card contains data about one species or taxon in one sample (abundance, number of juveniles, number of specimens in collection...);

- 3) the species file ("CarEsp") and the taxon file ("CarTax"). Soil ecologists currently work on biota identified at the species level for some group, and at a supra-specific level for other groups. The present version of ECOBASE/soil (Fig. 1) copes with this problem of data heterogeneity by handling species and supraspecific taxa in two separate files. These files include the information relative to the species and to the taxa: taxonomic name, family or group, data about distribution, morphological data (including size) relevant to ecological analyses, trophic category.

Additional files may contain information about biotic or abiotic parameters ("CarSol", "CarLit") and localisation of the samples ("Localisations", "Stations").

ECOBASE/soil uses the powerful searching and sorting tools of 4th Dimension to manipulate or to modify any subset of these data.

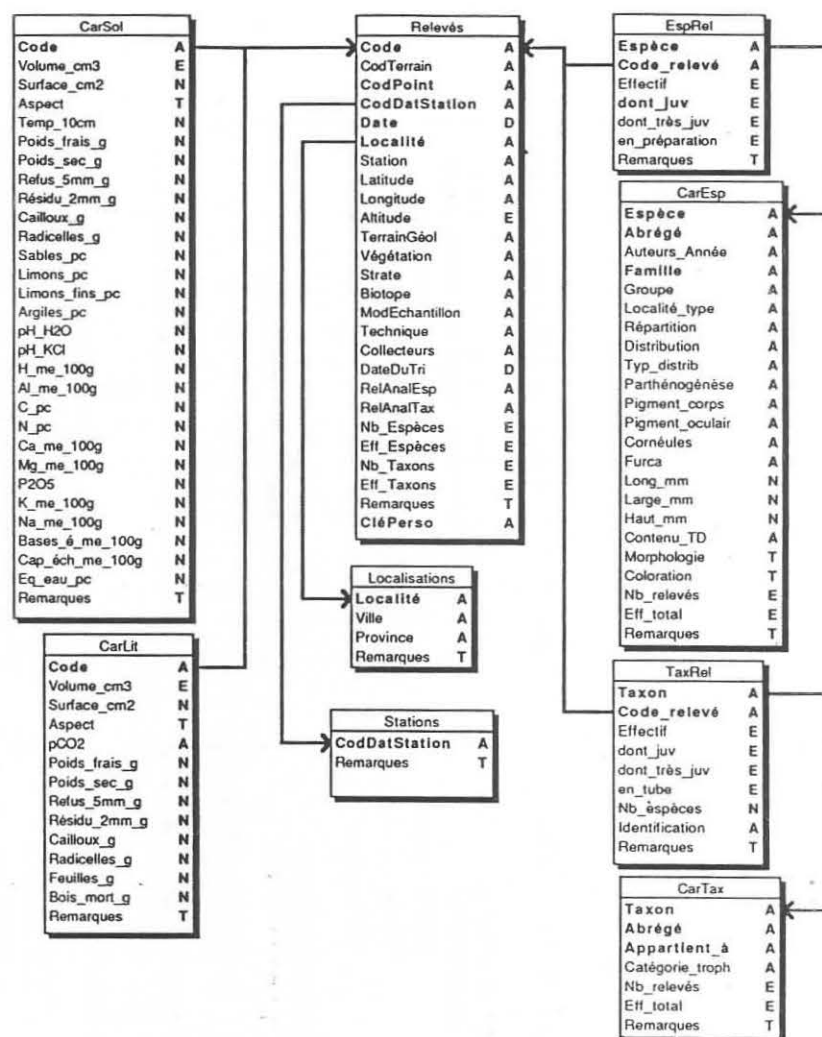
THE ANALYSIS TOOLS

ECOBASE/soil can perform a large array of analyses on any subset of the data, using the information about species/taxa and about sample parameters stored in the different files of the database. Analyses can be carried out either on samples, or on species/taxa. Measure of species/taxa importance can be expressed as abundance (the most usual way), density, estimated biovolume (for the species only, using information stored in the file "CarEsp"), or transformed values in several analyses. It is possible to discard the unidentified specimens (often juveniles) when necessary, specially for diversity measures.

Sample analyses

Analyses may concern either the samples of a set considered separately, or a set of samples as a whole. The following analyses have been implemented in ECOBASE.

- 1) Taxonomical /bioecological/ biogeographical spectra;
- 2) Diversity /heterogeneity (Shannon, Evenness of Shannon, N 1 of Hill, 1/Simpson, Evenness of Simpson, Berger-Parker, Margalef, Fisher Alpha, Q) (Fig. 2). When diversity indices are calculated separately for all samples of a selected set, the mean and standard deviation are given. When diversity indices are calculated from the



1. Structure of the database in ECOBASE/soil

selected set of samples considered as a whole. Jackknife estimates are proposed in option (KREBS, 1989);

3) Dominance measures (ratio between dominant taxa or species, importance of dominant species);

4) Rarefaction, cumulative richness (smoothed from a number of iterations fixed by the user), total richness estimators (PALMER 1990);

5) Abundance distribution fitting: geometric series and alpha log series are available; broken stick and log normal models are planned for future versions;

Example 1 - Diversity indices of a sample set

Paramètres généraux de l'analyse

Voulez-vous analyser les relevés

☐ relevé par relevé ? ☒ sur les espèces ?
☐ par point de relevés ? ☐ sur les taxons ?
☒ globalement ? ☐ sur les ordres ?
☐ Jackknife? (c'est long)

Sous quelle forme voulez-vous les résultats ?

☒ sortie écran/imprimante ☐ sortie ASCII

☐ Afficher les commentaires de l'analyse? ☐ Afficher les paramètres d'impression ?

Sélection des relevés

Localité _____
 Strate _____
 Végétation _____
 Altitude 1450 _____
 Technique Berlese _____

supérieur ou égal à _____
 CODE égal à Ah0 _____
 inférieur ou égal à _____

☐ Recherche plus précise (dialogue standard)

Example 2 - Ecological characterisation of a species

Sélectionnez les rubriques sur lesquelles porteront les analyses:

☐ biotope ☐ localité ☐ température
☐ strate ☐ technique ☐ pH eau
☒ végétation ☐ date ☐ matière organique
☐ terrain ☒ altitude ☐ C/N

Que voulez-vous calculer?

☒ les fréquences et abondances
☐ les densités et biovolumes

Définition des classes pour les altitudes

Valeurs observées			Valeurs par défaut	
minimale	maximale	Nb de valeurs distinctes	pas	Nb de catégories
935,00	1 550,00	6	123,00	5

Modifier la valeur minimale 900,00
 Modifier la valeur maximale 1 600,00
 Modifier le pas 350,00
 Modifier le nb de catégories 7

☐ Valider sur le pas (ce sont les catégories qui seront modifiées)
☒ Valider sur les catégories (c'est le pas qui sera modifié)
☐ Conserver les valeurs par défaut

Indices de diversité / Espèces

5 relevés analysés pour les espèces: Ah 1S, Ah 2S, Ah 3S, Ah 4S, Ah 5S

RELEVES	Nb UT	Eff.	Nb UT	Eff.	Shannon		N1 de	1/ Simpson		Berger	Margal	Alpha		Q
	total		sauf indét		Indice	Equit	Hill	Indice	Equit	Parker	ef	Indice	Var	
Calculs par relevés														
Ah 1S	10	107	10	107	2,25	0,677	4,76	3,57	0,684	0,39	1,93	2,7	0,729	2,213
Ah 2S	7	99	7	99	2,21	0,786	4,61	3,76	0,764	0,4	1,31	1,72	0,423	1,852
Ah 3S	8	106	8	106	2,23	0,744	4,7	3,6	0,705	0,44	1,5	2,01	0,504	1,674
Ah 4S	11	45	11	45	3,13	0,906	8,78	7,42	0,825	0,22	2,63	4,64	1,959	6,002
Ah 5S	10	62	10	62	2,67	0,805	6,38	4,92	0,728	0,35	2,18	3,37	1,138	2,731
moyennes	9,2	83,8	9,2	83,8	2,5	0,784	5,85	4,65	0,741	0,36	1,91	2,89	0,951	2,894
écart-types	1,6	28,5	1,6	28,5	0,4	0,08	1,8	1,64	0,06	0,08	0,53	1,17	0,63	1,78
globalement	20	419	20	419	2,96	0,685	7,77	4,9	0,576	0,38	3,15	4,38	0,958	n.c.

Caractérisation écologique de : *Folsomia manolachei*

20 relevés analysés pour les espèces: Ah10S, Ah11S, Ah12S, Ah13S, Ah14S, Ah15S, Ah16S, Ah17S, Ah18S, Ah19S, Ie10S, Ie11S, Ie12S, Ie13S, Ie14S, Ie15S, Ie16S, Re30S, Re31S, Re32S

	FREQUENCE				ABONDANCE			
	NRelT	NRel	Nrel*100 /		NeffT	Neff	Neff*100 /	
			ΣNrel	NrelT			ΣNeff	NeffT
par type de végétation								
Beech forest	10	9	81,81	90,00	825	82	78,09	9,93
Picea plantation	10	2	18,18	20,00	880	23	21,90	2,61
par altitude								
900-1250]	3	2	18,18	66,66	161	23	21,90	14,28
1250-1600]	17	9	81,81	52,94	1544	82	78,09	5,31

2. Two examples of analyses with main selection screens and printed output: 1 - diversity indices of a sample set; 2 - ecological characterisation of a species

6) Between-samples similarity (JACCARD, SORESENSEN and MORISITA). Lists of shared and non-shared species/taxa are provided, with abundances and frequencies in each sample or set of samples analysed.

Most diversity and similarity indices available in ECOBASE/soil are those recommended by MAGURRAN (1988), LUDWIG & REYNOLDS (1988), and KREBS (1989). A larger choice is proposed by the Biodiv programme of BAEV & PENEV (1993) running on PC.

Taxa analyses

1) Ecological characterisation. The niche of each species can be characterised:

- a) by the values (mean, standard deviation) of the measured abiotic parameters of the samples where the species is present;
- b) by the importance of the species in different classes of the measured or observed environmental parameters (Fig. 2); the limits or the number of the classes can be fixed by the user.

2) Spatial distribution (patchiness).

3) Between-taxa similarity, measured as between-samples similarity. Lists of the samples containing both species/taxa or only one of them are provided.

Data and results may be displayed on screen, printed or exported in text format for further statistical analyses, or for graphic representation as ECOBASE/soil has no graphical possibilities.

The current version of ECOBASE/soil is a French version under testing. A fully operational release is planned for the beginning of 1996.

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